

REMARKS

Applicant amends claims 142, 144, 146-148, 150-152, 154-156, and 158. Claims 143, 145, 149, 153, and 157 are cancelled without prejudice to their underlying subject matter. A mark-up version showing changes made to the claims is attached hereto.

Claims 142, 150, and 158 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. In view of the amendment to claims 142, 150, and 158, Applicants respectfully traverse the rejection and request reconsideration. The claimed subject matter, as amended, is supported by the specification at least at page 5, lines 21-27, connection with FIGS. 2-5. At least for these reasons, claims 142, 150 and 158 comply with 35 U.S.C. § 112, second paragraph, and the rejection thereunder should be withdrawn.

Claims 142 and 150 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Schellenberger et al. (U.S. Patent No. 5,714,203) in view of Ward et al. (U.S. Patent No. 5,988,186). Applicants respectfully traverse the rejection and request reconsideration.

Claim 142, as amended, defines a conditioning solution having a “fluorine source being selected from the group consisting of hydrofluoric acid, ammonium fluoride, and other fluorine donating chemicals” and a “complimentary acid being selected from the group consisting of phosphoric acid, hydrochloric acid, and combinations thereof” and a “non-aqueous solvent being selected from the group consisting of ethylene glycol, propylene carbonate, and blends thereof” and a “passivation agent comprising ascorbic acid, wherein said conditioning solution is substantially free of water,” and “said fluorine source, said complimentary acid, said non-aqueous solvent and said passivation agent are present in said conditioning solution in concentrations suitable for the selective removal of said residues relative to any exposed metal on said semiconductor substrate.” Neither Schellenberger et al.

nor Ward et al., taken individually or in combination, teaches or suggests the solution defined by claim 142.

Neither Schellenberger et al. nor Ward et al. teaches or suggests the recited non-aqueous solvent, recited to be selected from ethylene glycol, propylene carbonate, and blends thereof. Similarly, Schellenberger et al. and Ward et al. do not teach or suggest the recited passivation agent comprising ascorbic acid. Further, the cited references do not teach or suggest a conditioning solution that is “substantially free of water” as claimed. In fact, each of the references teaches away from this: Schellenberger et al. discloses that the main ingredient in its solution is “aqueous HF” (see, *inter alia*, column 2, line 42); Ward et al. discloses that all of its compositions are aqueous (see, *inter alia*, title and the Abstract, first line). Such disclosures foreclose the cited references from being used to reject the claims for obviousness.

Because Schellenberger et al. and Ward et al., combined or individually, would not have rendered the subject matter of claim 142 obvious, and actually teach away from the claimed solution (making use of such references improper), independent claim 142 is patentable thereover. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claim 142 be withdrawn.

Claim 150, as amended, defines a conditioning solution and recites “hydrofluoric acid or ammonium fluoride” and “hydrochloric acid or phosphoric acid” and “ethylene glycol or propylene carbonate” and “ascorbic acid acting as a surface passivation agent” in the solution. Schellenberger et al. and Ward et al., taken in combination or individually, do not teach or suggest the claimed solution.

Neither Schellenberger et al. nor Ward et al. teaches or suggests a solution that has ethylene glycol or propylene carbonate. Also, these references do not teach or suggest a solution that has ascorbic acid acting as a surface passivation agent.

Since Schellenberger et al. and Ward et al. would not have rendered the subject matter of claim 150 obvious, this claim is patentable thereover. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claim 150 be withdrawn.

Claims 143, 151, and 158-160 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Schellenberger et al. in view of Ward et al. and further in view of Verhaverbeke et al. (U.S. Patent No. 6,261,845). Applicants respectfully traverse the rejection and request reconsideration.

Claim 151, as amended, depends from claim 150 and further recites “said conditioning solution is substantially non-aqueous and is selective to the removal of said residues relative to exposed surfaces of metal lines over said semiconductor substrate.” As already discussed in relation to the patentability of claim 142, Schellenberger et al. and Ward et al. teach away from this recited element, making use of these references improper in rejecting claim 151 for obviousness. Additionally, claim 151 is patentable over these references for at least the same reasons as claim 150, as discussed above. Verhaverbeke et al. can add nothing to the disclosures of these primary references to have rendered the subject matter of claim 151 obvious.

Claim 158, as amended, defines a conditioning solution “consisting essentially of a fluorine source, a complementary acid, a non-aqueous solvent and a surface passivation agent, wherein said conditioning solution is substantially non-aqueous and is selective to removal of said residues relative to metal lines exposed over surfaces of said semiconductor substrate.” The deficiencies of Schellenberger et al. and Ward et al. are described above in relation to independent claims 142 and 150. At least for the same reasons as described above, claim 158 is allowable.

Neither Schellenberger et al. nor Ward et al. teaches or suggests a solution “consisting essentially of a fluorine source, a complementary acid, a non-aqueous solvent and a surface passivation agent” as acknowledged in the Office Action (Paper 13 at 5). As also acknowledged in the Office Action, Verhaverbeke et al. is directed to a method for determining/calculating chemical concentration in a wet processing stream formed of two or more liquid streams, not in any way to controlling the concentrations or amounts of chemicals in a solution or to limiting a solution to certain useful chemicals. Verhaverbeke et al.’s disclosure does not contribute to those of Schellenberger et al. and Ward et al. to teach or suggest a solution “consisting essentially of a fluorine source, a complementary acid, a non-aqueous solvent and a surface passivation agent” as claimed. Verhaverbeke et al. would only be useful if one wanted to determine the amounts/concentrations of chemicals in the disclosed solutions of Schellenberger et al. or Ward et al., but it is not useful in teaching or suggesting the exclusion or selection of certain chemicals to be combined in such solutions, as required by and recited in claim 158.

Since claim 143 is cancelled, and the cited references would not have rendered the subject matter of claims 151 or 158 obvious, claim 151, independent claim 158 and depending claims 159 and 160 are patentable. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claims 151, 158-160 be withdrawn.

Claims 144-149 and 152-157 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Schellenberger et al. in view of Ward et al. and further in view of Verhaverbeke et al. Applicants respectfully traverse the rejection and request reconsideration.

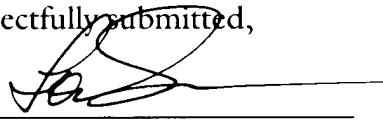
Schellenberger et al., Ward et al., and Verhaverbeke et al., and their respective deficiencies, are extensively described above in relation to the patentability of claims 142, 150 and 158. Claims 144-149 and 152-157 depend either directly or indirectly from claims 142 and 150, both of which are described above. At least for the reasons discussed above, claims

144-149 and 152-157 are allowable over the cited references and also because the cited references, taken alone or in combination, fail to teach or suggest the respective inventive combinations defined by claims 144-149 and 152-157. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claims 144-149 and 152-157 be withdrawn.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejections of the claims and to pass this application (with claims 142, 144, 146-148, 150-152, 154-156, and 158-160) to issue.

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Respectfully submitted,

By 

Thomas J. D'Amico

Registration No. 28,371

Ryan H. Flax

Registration No. 48,141

DICKSTEIN SHAPIRO MORIN &
OSHINSKY LLP

2101 L Street NW

Washington, DC 20037-1526

(202) 828-2232

Attorneys for Applicants

Mark-Up Version Showing Changes Made

142. (Three Times Amended) A conditioning solution for use in removing residues remaining on a semiconductor substrate after a dry etch process, said conditioning solution comprising:

a fluorine source, said fluorine source being selected from the group consisting of hydrofluoric acid, ammonium fluoride, and other fluorine donating chemicals;

a complimentary acid, said complimentary acid being selected from the group consisting of phosphoric acid, hydrochloric acid, and combinations thereof;

[propylene glycol] a non-aqueous solvent, said non-aqueous solvent being selected from the group consisting of ethylene glycol, propylene carbonate, and blends thereof; and

[citric acid acting as] a surface passivation agent, said passivation agent comprising ascorbic acid, wherein

 said conditioning solution is substantially [non-aqueous] free of water, and
 [configured to minimize the removal of metal lines from exposed surfaces of said semiconductor substrate while said residues are being removed from said semiconductor substrate] said fluorine source, said complimentary acid, said non-aqueous solvent and said passivation agent are present in said conditioning solution in concentrations suitable for the selective removal of said residues relative to any exposed metal on said semiconductor substrate.

143. (CANCEL)

144. (Amended) The solution of claim 142, wherein said [hydrofluoric acid, phosphoric acid, propylene glycol, and citric acid are present in said solution in the approximate proportion of 0.01 – 5.0 : 1-15 : 80 – 90 : 0.001 – 1.0] passivation agent contributes to said selective removal by said solution by passivating said any exposed metal on said semiconductor substrate.

145. (CANCEL)

146. (Amended) The solution of claim 142, wherein said [hydrofluoric acid, phosphoric acid, propylene glycol, and citric acid are present in said solution in the approximate proportion of 0.25 – 0.3 : 6 – 7 : 90 – 94 : 0.009 – 0.5] fluorine source contributes to said selective removal by said solution by substantially remaining in molecular form.

147. (Amended) The solution of claim 146, wherein said [solution comprises approximately 0.25 to approximately 0.3 percent hydrofluoric acid, approximately 6 to approximately 7 percent phosphoric acid, approximately 90 to approximately 94 percent propylene glycol, and approximately 0.009 to approximately 0.5 percent citric acid] complimentary acid is present in sufficient amount to contribute to said fluorine source substantially remaining in molecular form.

148. (Amended) The solution of claim 142, wherein said [hydrofluoric acid, phosphoric acid, propylene glycol, and citric acid are present in] fluorine source, said complimentary acid, said passivation agent, and said non-aqueous solvent are present in said solution in [the approximate proportion of 0.27 : 6.5 : 91.5 : 0.25] sufficient concentrations to suppresses the solubility of aluminum fluoride.

149. (CANCEL)

150. (Three Times Amended) A conditioning solution for use in removing residues remaining on a semiconductor substrate after a dry etch process, said conditioning solution comprising:

hydrofluoric acid or ammonium fluoride;

hydrochloric acid or phosphoric acid;

[propylene glycol] ethylene glycol or propylene carbonate; and

[citric] ascorbic acid acting as a surface passivation agent [, wherein

said conditioning solution is substantially non-aqueous and configured to minimize the removal of metal lines from exposed surfaces of said semiconductor substrate while said residues are being removed from said semiconductor substrate].

151. (Amended) The solution of claim 150, wherein said conditioning solution [consists essentially of hydrofluoric acid, hydrochloric acid, propylene glycol, and citric acid] is substantially non-aqueous and is selective to the removal of said residues relative to exposed surfaces of metal lines over said semiconductor substrate.

152. (Amended) The solution of claim 150, wherein said [hydrofluoric acid, hydrochloric acid, propylene glycol, and citric acid are present in said solution in the approximate proportion of 0.01 – 5.0 : 0.003 – 1.0 : 80 – 99 : 0.001 – 1.0] passivation agent contributes to said selective removal by said solution by passivating said metal lines over said semiconductor substrate.

153. (CANCEL)

154. (Amended) The solution of claim 150, wherein said hydrofluoric acid or ammonium fluoride [, hydrochloric acid, propylene glycol, and citric acid are present in said solution in the approximate proportion of 0.25 – 0.3 : 0.005 – 0.009 : 90 – 98 : 0.009 – 0.5] contributes to said selective removal by said solution by substantially remaining in molecular form.

155. (Amended) The solution of claim 154, wherein said [solution comprises approximately 0.25 to approximately 0.3 percent hydrofluoric acid, approximately 0.005 to approximately 0.009 percent] hydrochloric acid [, approximately 90 to approximately 98 percent propylene glycol, and approximately 0.009 to approximately 0.5 percent citric acid] or phosphoric acid is present in sufficient amount to contribute to said hydrofluoric acid or ammonium fluoride substantially remaining in molecular form.

156. (Amended) The solution of claim 150, wherein said hydrofluoric acid or ammonium fluoride, said hydrochloric acid or phosphoric acid, [propylene glycol, and citric acid] said ethylene glycol or propylene carbonate, and said ascorbic acid are present in said solution in [the approximate proportion of 0.27 : 0.006 : 97.5 : 0.25] sufficient concentrations to suppresses the solubility of aluminum fluoride.

157. (CANCEL)

158. (Three Times Amended) A conditioning solution for use in removing residues remaining on a semiconductor substrate after a dry etch process consisting essentially

of a fluorine source, a complementary acid, a non-aqueous solvent and a surface passivation agent, wherein

said conditioning solution is substantially non-aqueous and [configured to minimize the removal of] is selective to removal of said residues relative to metal lines [from] exposed over surfaces of said semiconductor substrate [while said residues are being removed from said semiconductor substrate].